

HOSPITAL NETWORKS

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2.nd European Summer School on Telemedicine

TELEIMAGING IN MEDICINE

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The development of
**Picture Archiving & Communication
Systems (PACS)**
installations in Italy

and of their integration with

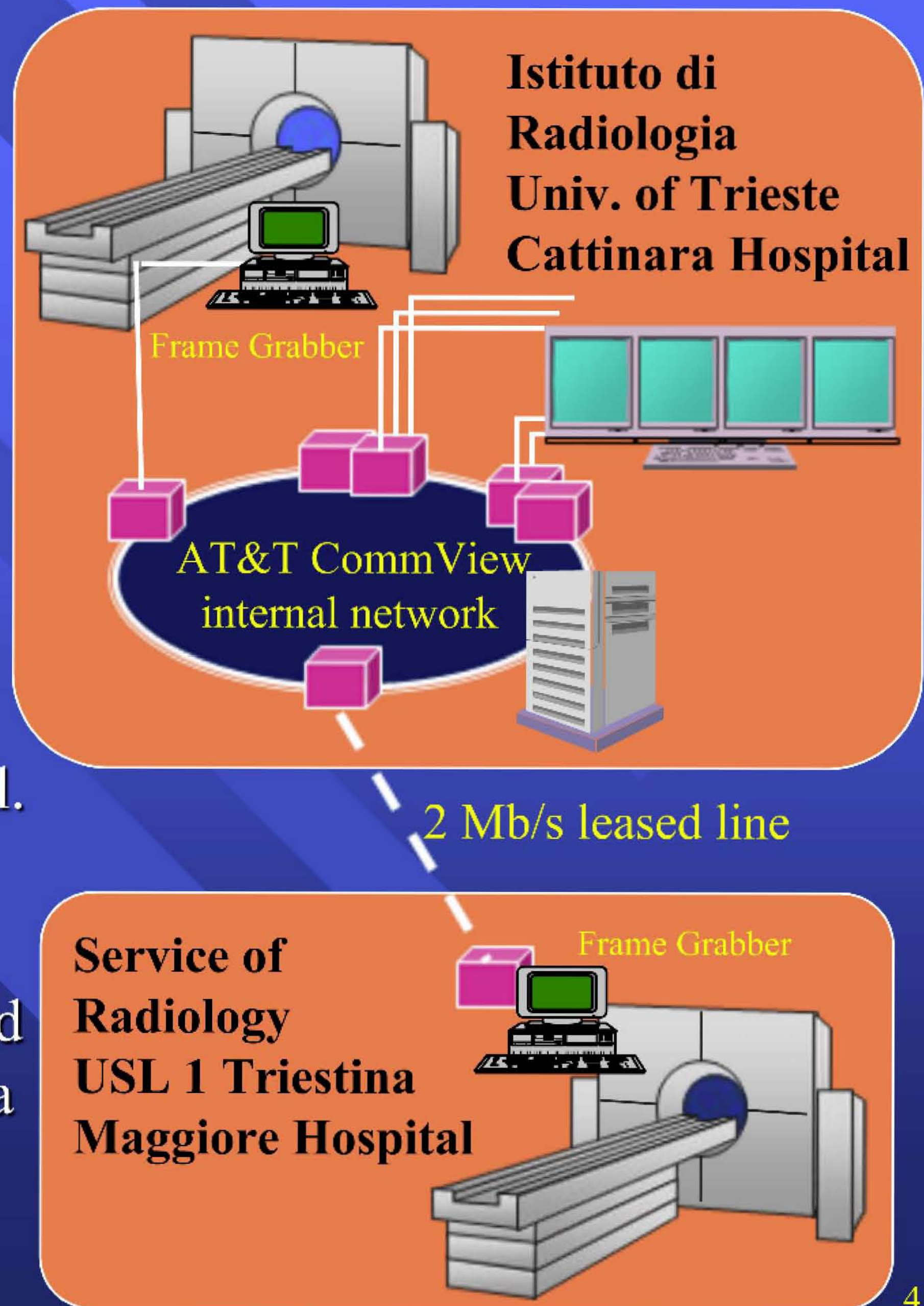
Radiological Information Systems (RIS)
and
Hospital Information Systems (HIS)

EARLY PACS INSTALLATIONS IN ITALY

- 1987: the development of PACSs in Italy initiated with some delay with respect to other countries in Europe
- in few years Italy became the country in Europe with the greatest number of commercial PACS systems
- 1988: the first system - an AT&T CommView PACS - was installed by Philips at the Local Health Unit of Trieste, in the Istituto di Radiologia of the University of Trieste.

Trieste: the first Italian PACS installation

- main system located in the **Radiology Department of the University of Trieste** at the Cattinara Hospital
- a second, slave system, installed at the Radiology Service of Maggiore Hospital.
- 1990: the two sub-systems inter-operated correctly by means of a protocol-dedicated 2 Mb/s leased line, by using a proprietary At&T communication protocol





the EC AIM project on PACS Evaluation

- 1989: the EC promoted the AIM Project
«Operational Evaluation and Basic
Requirements for Prospective Evaluation of
PACS Technology»

– main contractor:



– Italian partners:

Research Park of Trieste
University of Florence
University of L'Aquila
Italsiel

growing of commercial PACS installations in Italy



- The AIM project
and
- the positive results coming from
the evaluation of the first PACS
installation of Trieste



stimulated and supported the rapid
growth of other seven
Philips/AT&T Commview
installations in Italy

PACS installations in Italy during early 1990's

CITY	SITE	SUPPLIER	YEAR
Trieste	Cattinara Hospital Univ. of Trieste	Philips/AT&T Commview	1988
Bologna	Maggiore Hospital	Philips/AT&T Commview	1990
Ferrara	Sant'Anna Hospital	Philips/AT&T Commview	1990
L'Aquila	Collemaggio Hospital Univ. of L'Aquila	not commercial	1990
Trieste	Maggiore Hospital	Philips/AT&T Commview	1990
Messina	Messina Hospital	Philips/AT&T Commview	1991
Bari	Mater Dei Clinic	Philips/AT&T Commview	1992
Castelfranco	Castelfranco Hospital	Philips/AT&T Commview	1992
Milano	S. Paolo Hospital	Philips/AT&T Commview	1992
Monza	S. Gerardo Hospital	Philips/AT&T Commview	1992

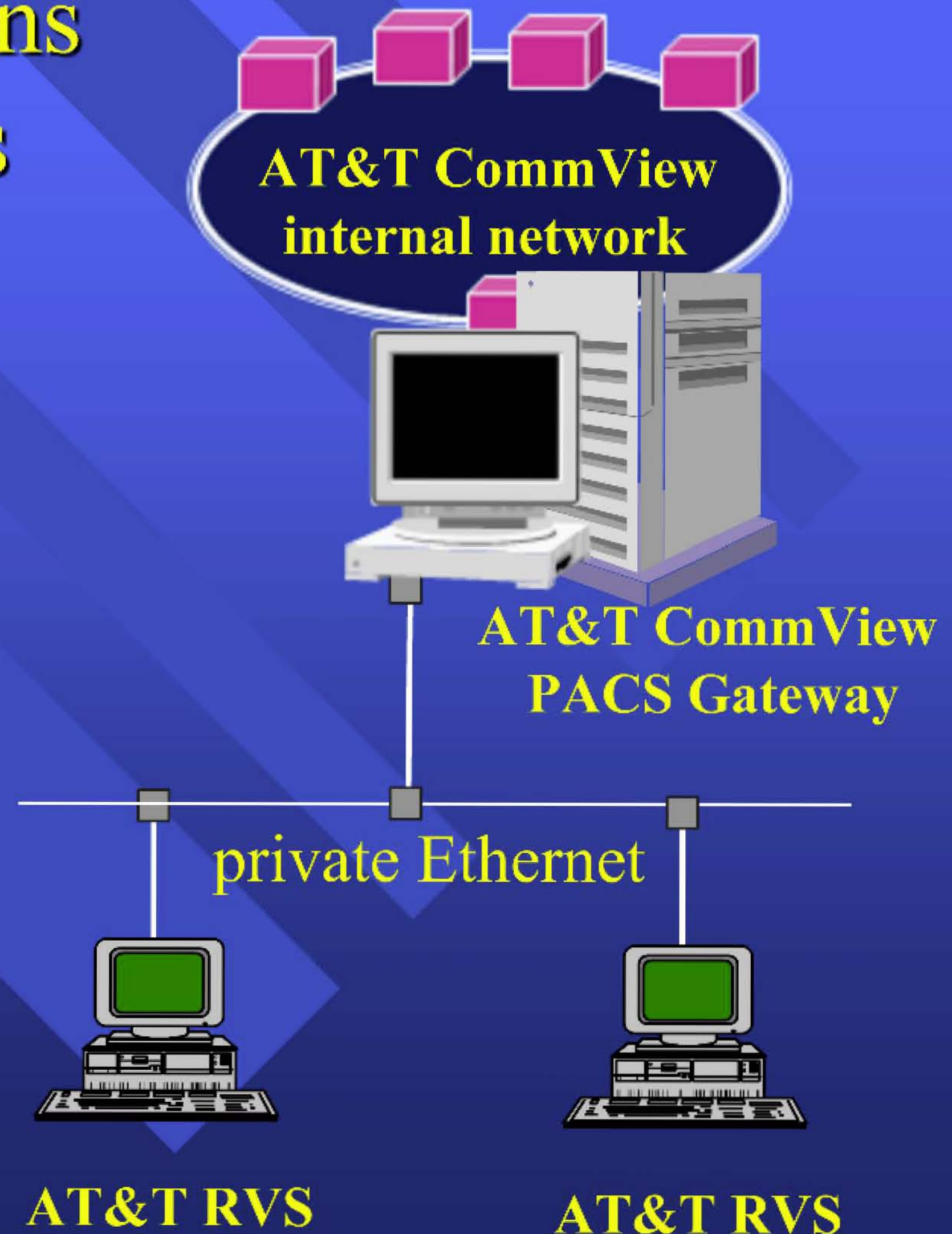
The non-commercial PACS at L'Aquila

- 1987-1990: a non-commercial PACS/RIS system was developed by the **Istituto di Radiologia of the University of L'Aquila**
- 1990: the PACS system was made operative at the Collemaggio Hospital of L'Aquila.
- differently from the commercial systems, this system used standard protocols at all levels: **Ethernet**
DECNET
ACR-NEMA



PACS Commview external communications in Italian installations

- Most of the Commview PACS Italian installations worked (and till work today) essentially inside the protocol-proprietary optical-fiber network in the radiology departments
- Sometimes they operated also on an external but dedicated Ethernet network, by using:
 - an AT&T Gateway and
 - quite expensive AT&T Results Viewing Stations (RVS).



PACS Commview external communications in Italian installations

- 1992, at Trieste: a joint research program of



the Unit of Trieste of the National Group of Bioengineering at the DEEI - Dipartimento di Elettrotecnica, Elettronica ed Informatica of the University of Trieste

and

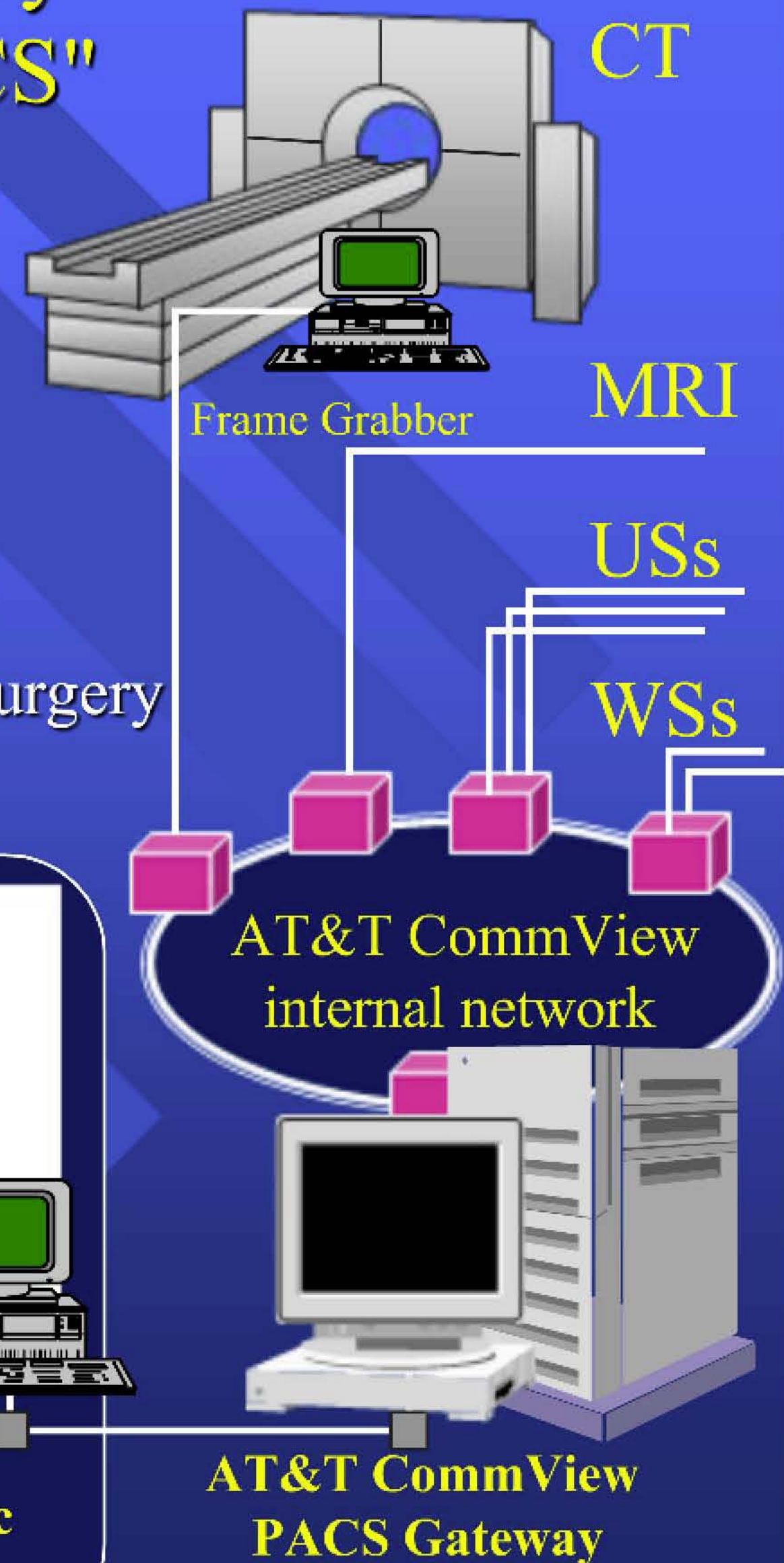


the Centro Ricerche e Studi Tecnologie Biomediche e Sanitarie at the Research Park of Trieste

- the AT&T Commview Gateway at the Istituto di Radiologia was connected to the Cattinara Hospital optical-fiber network

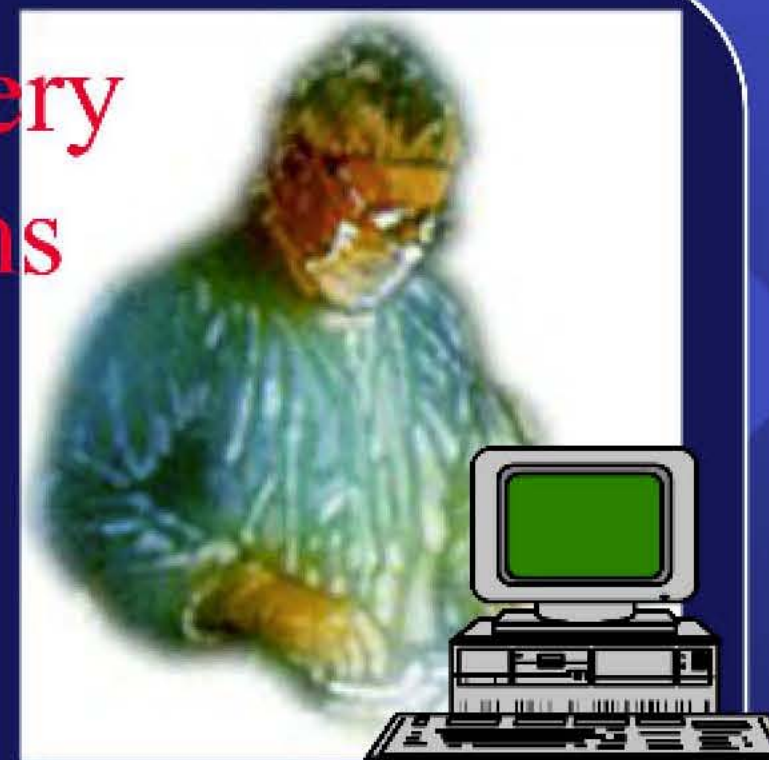
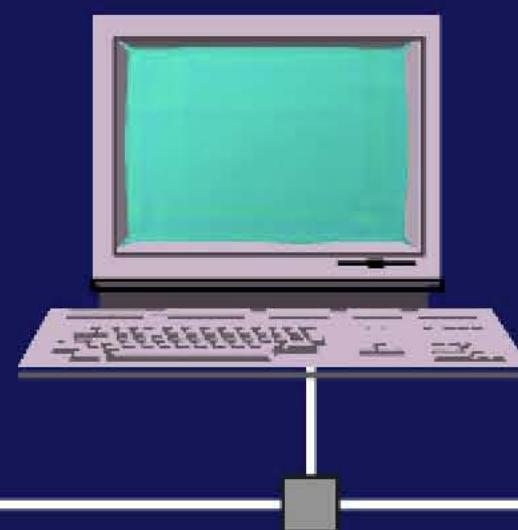
Trieste: Cattinara Hospital Radiology services with the "Commview PACS"

- ISO/OSI compliant Remote access to PACS
- Development of Open and Versatile Tools for Remote Multi-Platform Workstations
 - 1992: XRIS - X-Window Remote Image Station
 - 1993: ARIS - Autonomous Remote Image Station
 - 1994: SRIS - Integration with Stereotactic Neurosurgery
 - 1995: HRIS - HTML/HTTP browser



hospital clinics

surgery
rooms



MS-DOS/Windows
PC WorkStation

Unix
WorkStation

X-RIS
Image Server

Stereotactic
Neurosurgery

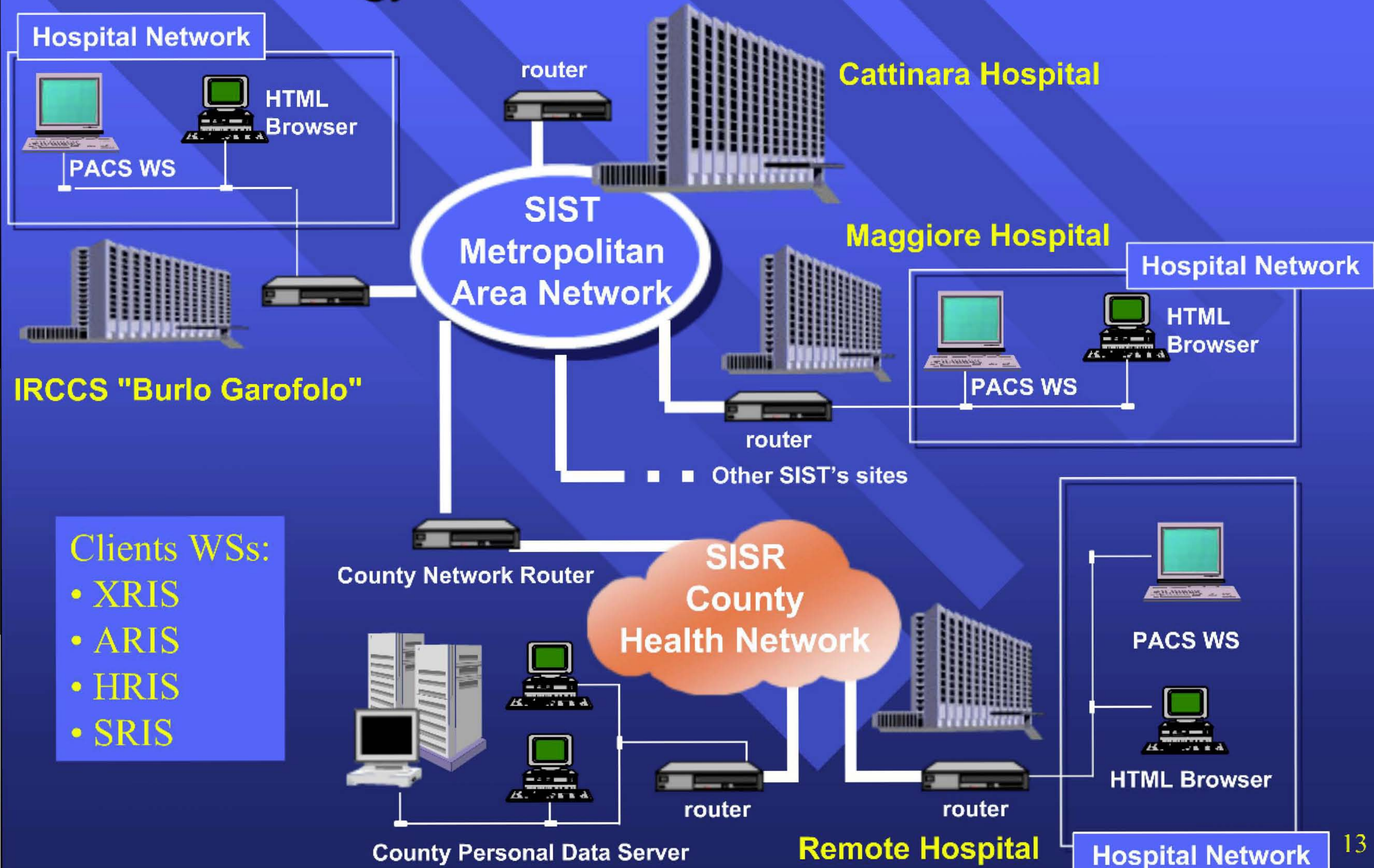
AT&T CommView
PACS Gateway

WAN-availability in Trieste of Pacs Commview images

- **1990:** the Cattinara Hospital network was connected (with access-lists to assure security and privacy)
 - to the high-speed Metropolitan Area Network of the SIST (Sistema Informatico Scientifico Triestino) and
 - to the SISR (the Regional Health IP WAN of the Regione Friuli Venezia Giulia)
- **1992:** The PACS archive was made available to all the hospitals of Trieste and also to any other site on the network, by means of:
 - Unix- or PC-based remote client stations (XRIS, ARIS)
 - [1995] a WWW gateway and browsers (HRIS)

Trieste & Regione FVG: MAN and WAN

Radiology services with the "Commview" PACS



NEW PACS PROJECTS, DEVELOPMENTS AND INSTALLATIONS

- mid 1990's: with few exceptions, the new projects, developments and installations of PACSs in Italy started in hospital sites and research centers different from those of the first PACS installations.
- This may be partially due to the inherent difficulty for most of the sites to integrate the PACS systems of the first generation with the open and standard environment of our days.

- as in most of the world, a transition
 - from the concept of the (closed) PACS system just collecting all the images within a radiology department
 - to the concepts of
 - » open and standard systems
 - » integrated health care environments
 - » world-wide remote consultation and exchange of images
 - » network image processing
 - » combined processing and integration of morphological and functional (e.g. EEG maps) images.

there has been also in Italy

The National Project of Telemedicine

- 8 themes
- 1.st theme: create integrated and integrable information systems for the hospital management
- 3.rd theme: develop and build-up a system for acquisition and processing of radiological digital images and a system for the diagnostic support.
- 5.rd theme: develop a telematic system for the management of a cardiology department



National Project of Telemedicine 3° Theme

- **duration:** August 1995 - March 1998
- **1.st sub-theme:** a system for the acquisition, management, archiving and transmission of radiological images
- **2.st sub-theme:**
 - > systems for diagnosis support
 - > systems for reporting support

- development:
by some Italian industries



coordinated by



and by some scientific centers





■ experimentation:
by five clinic centers:

- Dip. di Fisiopatologia Clinica - Univ. of Florence
- Ist. di Radiologia - Univ. of Pisa
- Ist. di Radiologia - Univ. "La Sapienza" of Rom
- Centro di Medicina Nucleare - CNR of Naple
- Servizio di Radiodiagnostica - Ist. Naz. dei Tumori of Milan

Telemed network

The five clinic centers are connected:

- to the Toscana MAN

or

- to the GARR Italian Network

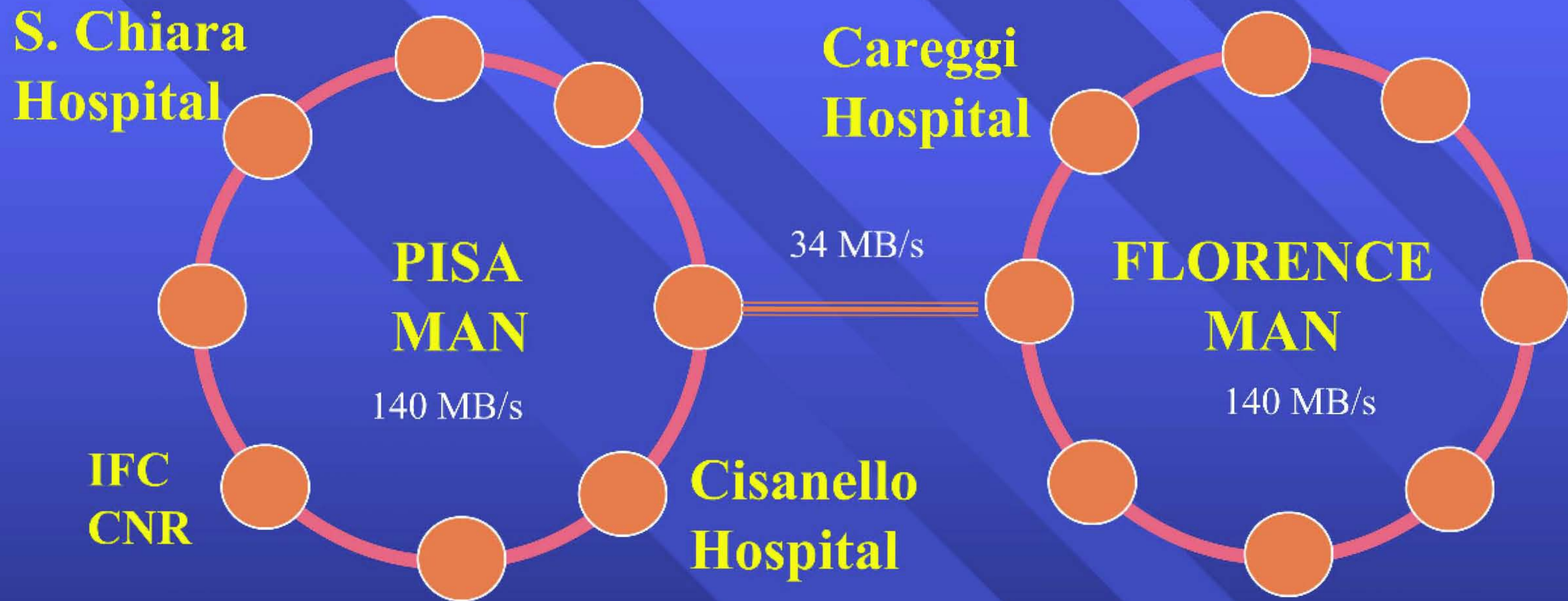


Metropolitan & Regional tele-radiology at the Dipartimento di Radiologia of Pisa



- metropolitan tele-radiology between the hospitals Santa Chiara and Cisanello in Pisa
- regional tele-radiology between the
 - dept. of Cardiology of the Santa Chiara Hospital in Pisa and
 - dept. of Radiology of the Careggi Hospital at Florence
- Geographical communications are made by using the Metropolitan Area Network linking Pisa and Florence

Metropolitan & Regional tele-radiology at Pisa and Florence



- Images are essentially stored on a "modular" PACS simply made by an Ethernet interconnection of the imaging modalities, using DICOM or other proprietary protocols.



The SPERIGEST Project at the IFC-CNR of Pisa

- oct. 1996: the IFC of CNR at Pisa, as Azienda Ospedaliera CREAS-IFC, starts **SPERIGEST**
a "special program" of the Ministry of Health
- with the collaboration of ItalTBS - Research Park of Trieste
- duration: 24 months
- the project utilizes the connection facilities of the Toscana MAN



The SPERIGEST Project at the IFC-CNR of Pisa

- the aim of the project is an integrated system collecting

- clinical components
- administrative components
- government components

within a Health local unit.

integrated clinic card:

- data and signals from labs of CREA-IFC
- data and signals from clinics of CREA-IFC
 - clinical chemistry
 - hemodynamics
 - ecography
 - nuclear medicine
 - PET
 - holter
 - ECG
 - ergonometry
 - etc.

The PACS/RIS system at the Dep. of Radiology II of the University "La Sapienza" of Rom

- A PC-based PACS/RIS system with hypermedia capabilities has been recently developed, installed and evaluated.
- The PACS section is being upgraded to a Unix-based system from Imation
- The system supports
 - scheduling
 - recording
 - examination
 - reporting
 - statistics
 - system administration
 - image archiving of secondary caption images from video or scanning.





Center for Biomedical Applications of CRS4 at Cagliari

- development of WWW-Intranet based techniques:
- **W-MED**: an electronic patient record system that allows to securely view clinical information including:
 - medical images
 - data
 - signals associatedwith individual patients
- **Wolviz**: a medical 3D visualization systems.

Trieste - The DPACS project

- **1996:** following the previous experience, a large project called DPACS (Data and Picture Archiving and Communication System) has been started
- **Aim of the project:** develop an **open system** for the archiving and remote consultation of **radiological images** as well as of other **data and signals**.
- **Final goal:** offer a **citizen's** virtually integrated **clinical card** available to **all the population** of the Provincia of Trieste, through the network **at any hospital and private health site**
- **1997:** start of radiology HIS/RIS/PACS service

The DPACS Project

Data & Picture Archiving and Communication System

- Replacement of current PACS System
- Full HIS-RIS-PACS Integration
- Medical Records Access from any location
 - » Intra-Hospital services
 - » MAN and WAN interoperability
- Support for DICOM and non-DICOM devices



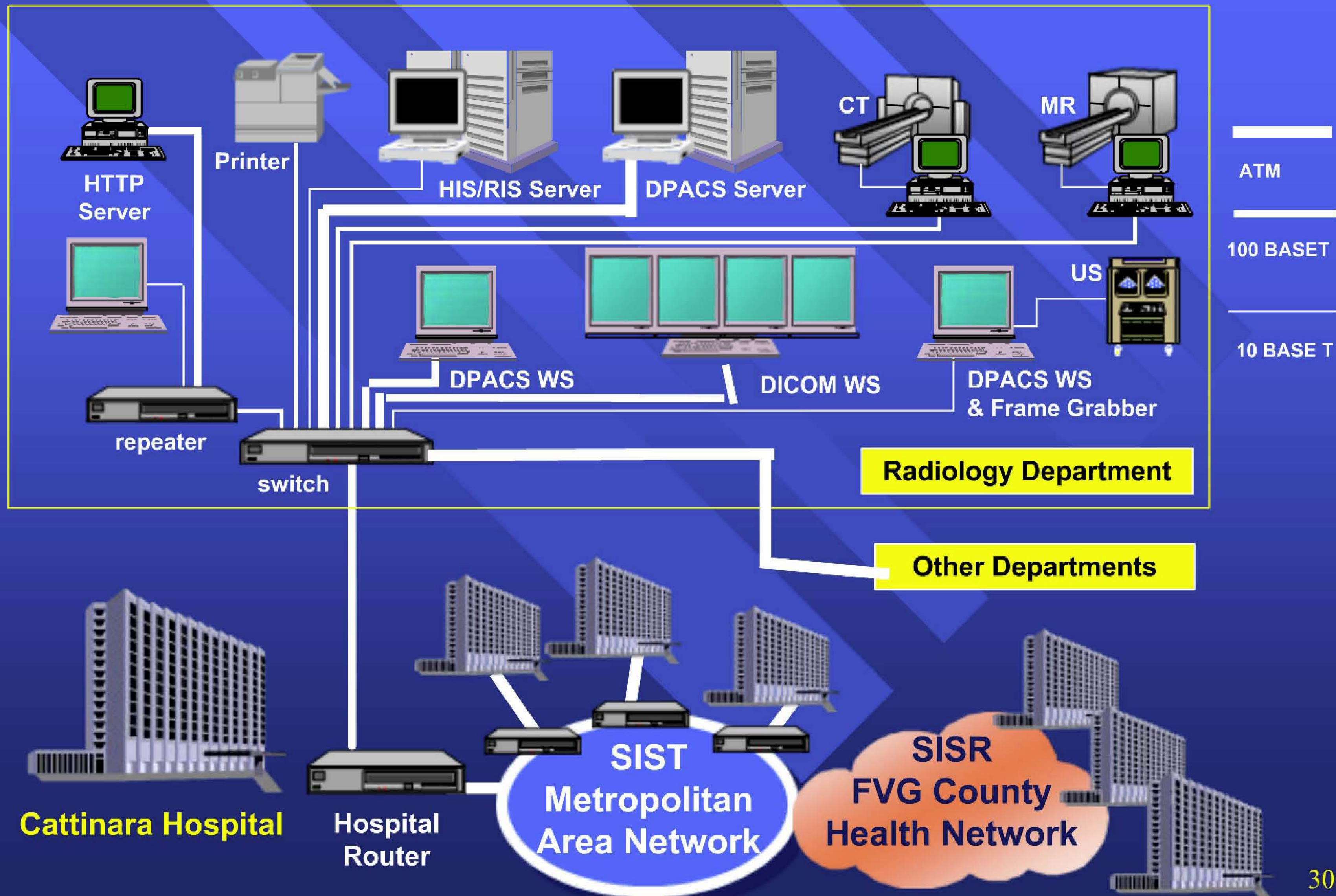
The DPACS Project

Data & Picture Archiving and Communication System

- Heterogeneous Medical Data Storage
- Three-level Hierarchical Data Storage
- Relational/Distributed DataBase Engine
- Multi-platform Client-Server architecture



DPACS Cattinara Hospital Network





R&D
Group



The DPACS Projects

Clin.&Econ.
Eval. Group



Target
Institutions



the DPACS project: industrial collaborations

DPACS
integration with
no-standard
environments and
DICOM testing



virtual integrated health
card and
PACS/RIS/HIS
integration in FVG and
other Italian counties



INSIEL S.p.A.



transfer to cardiology of DPACS
potentialities and functionalities

market study and user-matched
integration of radiological PACSs with
local and geographical HIS systems



**joined R&D
and
key production**

- integration of legacy-protocol-oriented administrative services with Intranet client/server systems
- high performance health networking



**HW support & and
wide area telematics
experimentation**



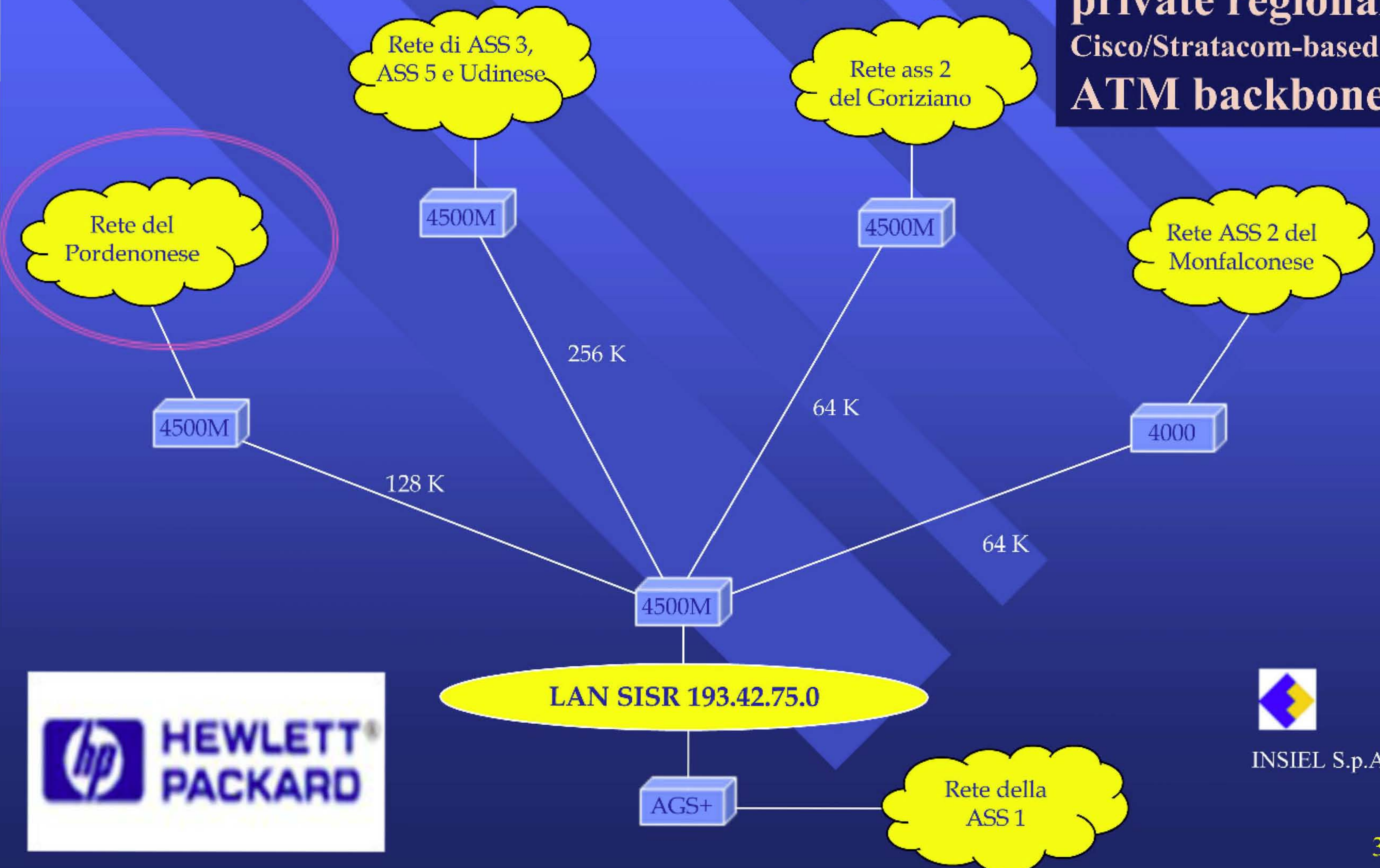
The DPACS project in the Regione FVG



- The Government of the Regione Friuli Venezia Giulia, has considered strategic that the **model of the DPACS project** is extended, with suitable adaptations, to the **the health integration of all the county**
- Some experimental integrations have been programmed by the regional committee of health care communication:
 - DPACS (Trieste)
 - PACS/RIS (Aviano, PN)
 - Regional Cardio-Net
 - Telepatology-Net (Udine)

SISR - FVG Regional Health Network WAN Backbone (1996)

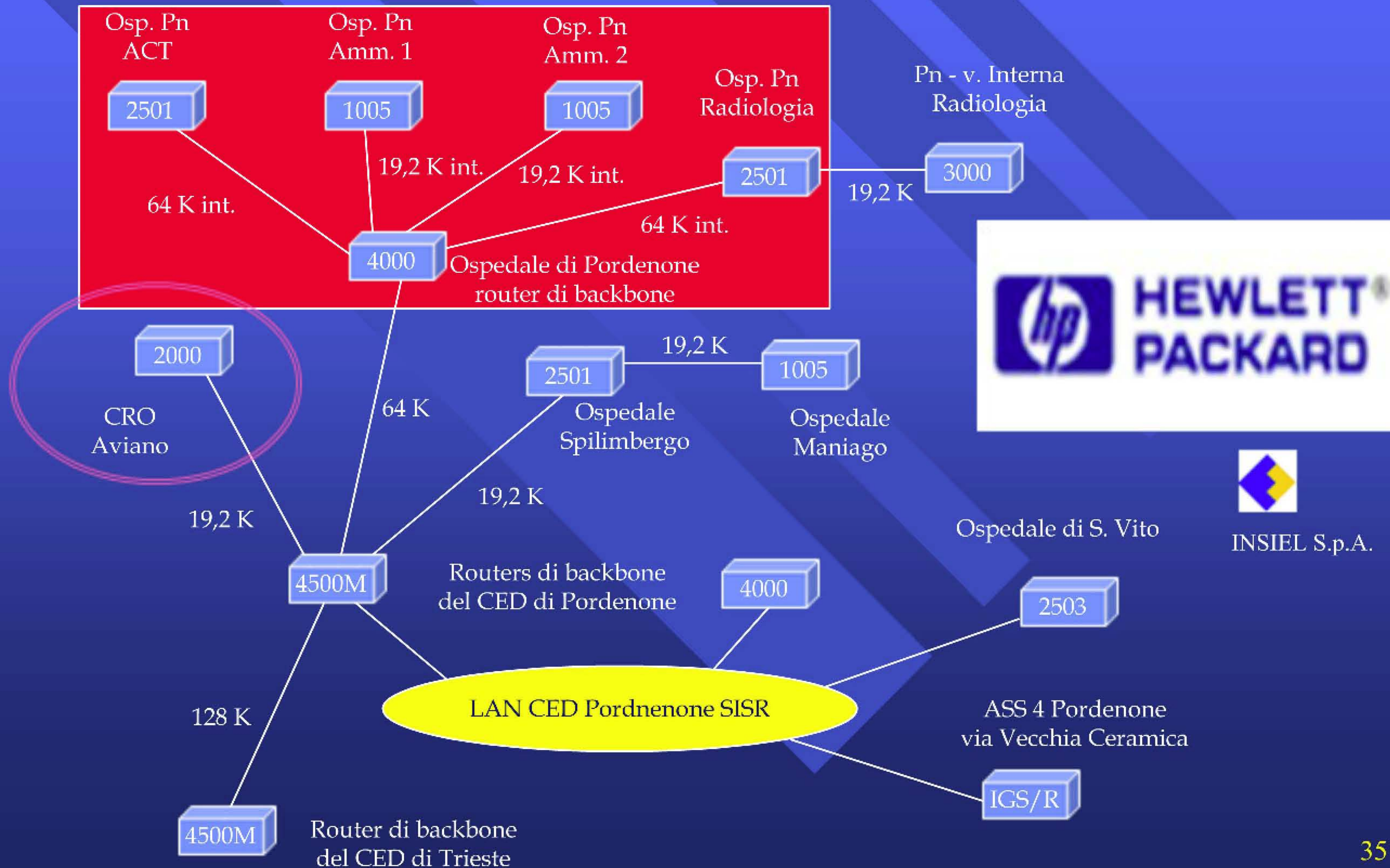
**end of 1997:
upgrade to a
private regional
Cisco/Stratacom-based
ATM backbone**



INSIEL S.p.A.

SISR - FVG Regional Health Network

WAN Backbone of Provincia di Pordenone (1996)



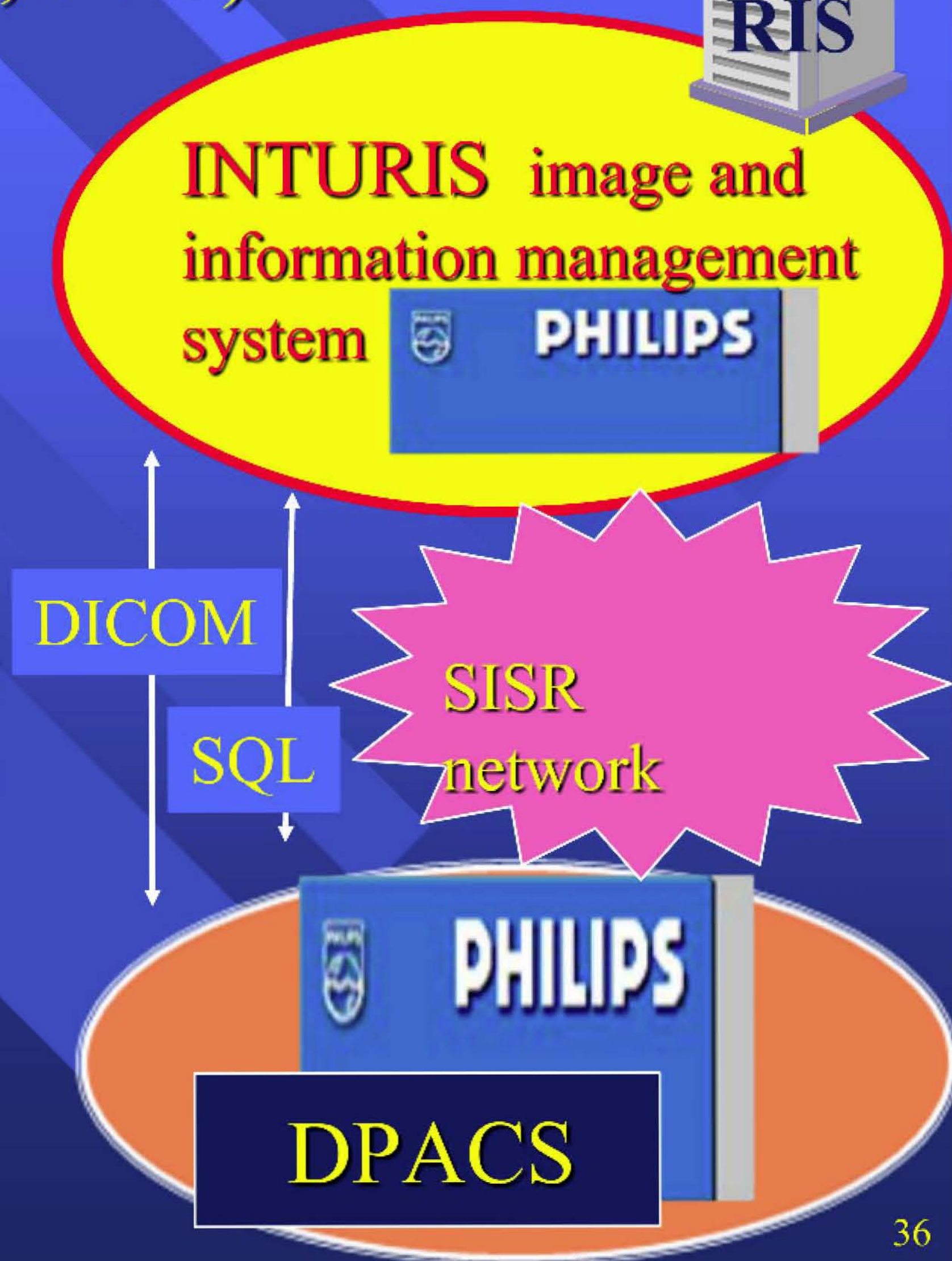
Centro Riferimento Oncologico CRO of Aviano (Pordenone, FVG)



INSIEL S.p.A.

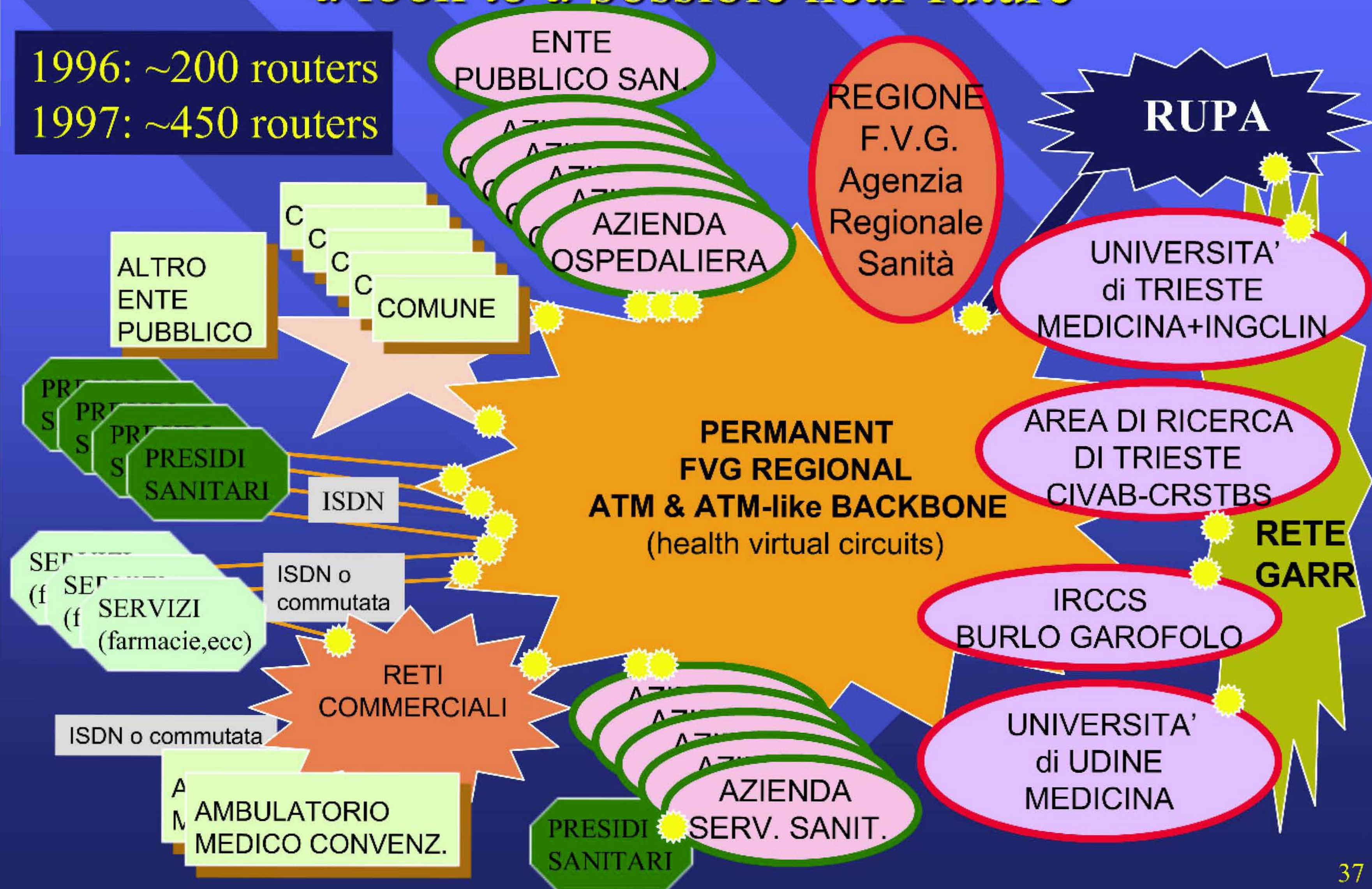


- 1995-1996: A large commercial PACS of the new generation, developed by Philips has been installed at the Department of Radiology of CRO
- The PACS has been integrated with the Insiel RIS
- It is connected to the SISR WAN
- A first experience of radiological regional cooperation/consulting with the DPACS Project at Trieste through the SISR Regional Network is starting



The FVG Health Network: a look to a possible near future

1996: ~200 routers
1997: ~450 routers



DPACS <--> SSIC

Italian Agreements

- extensions
- integration
- collaborations

of the DPACS project to other Italian sites can be feasible thanks to the 18 agreements of didactic and research collaboration signed by the SSIC - the post-graduate School of Clinical Engineering of Trieste with hospital, companies and institutions in all Italy:





Formal agreements

- Area di Ricerca di Trieste
- Azienda Ospedaliera «Ospedale Niguarda Ca' Grande», Milano
- Azienda Ospedaliera «S. Maria degli Angeli», Pordenone
- Azienda Ospedaliera di Bologna
- Azienda Ospedaliera di Forlì
- Azienda Ospedaliera di Padova
- Azienda Ospedaliera di Trieste
- Azienda per i Servizi Sanitari n.1 Triestina, Trieste
- Azienda per i Servizi Sanitari n.16 di Modena
- Azienda Sanitaria USL Centro-Sud - Bolzano
- Azienda USL n. 2 di Lucca
- CRSTBS, Trieste
- INSIEL S.p.A., Trieste and Udine
- IRCCS “Casa Sollievo della Sofferenza”, San Giovanni Rotondo (Foggia)
- IRCCS Ospedale Infantile "Burlo Garofolo", Trieste
- *IRCCS «San Raffaele», Milano (to be signed)*
- Istituto di Fisiologia Clinica del C.N.R., Pisa
- ITALTBSS.p.A., Trieste
- Unità Locale Socio-Sanitaria n. 7, Pieve di Soligo (Treviso)

Other Italian PACS/RIS and teleradiology new or future installations in depts. of radiology

- **Bolzano, Azienda Sanitaria USL Centro-Sud:**
 - AGFA Digital Radiology with distributed DICOM WSs
 - Siemens PACS system, intra- & inter-hospitals
- **Ravenna+Feanza+Lugo di Romagna (Regione ER), ASS:**
 - Imation teleradiology system
- **Lodi (Milano), ASS:**
 - Imation PACS archive manager integrated with RIS
- **Tortona, ASS:**
 - Imation PACS archive manager + digitizer
- **Rome, University "La Sapienza":**
 - Imation PACS archive manager integrated with RIS